



# Leveraging Executable Architectures in a Joint Environment

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# Purpose

*Detail analysis utilizing executable architectures and demonstrate its capabilities to support Joint Systems Engineering analysis*



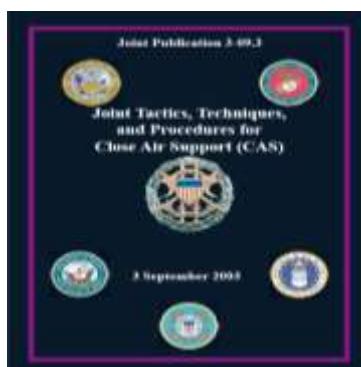
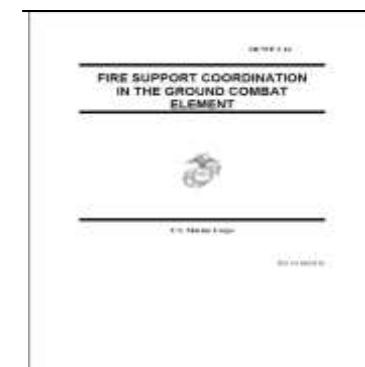
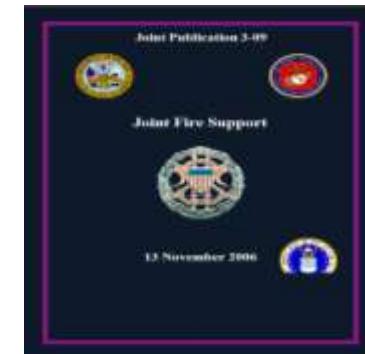
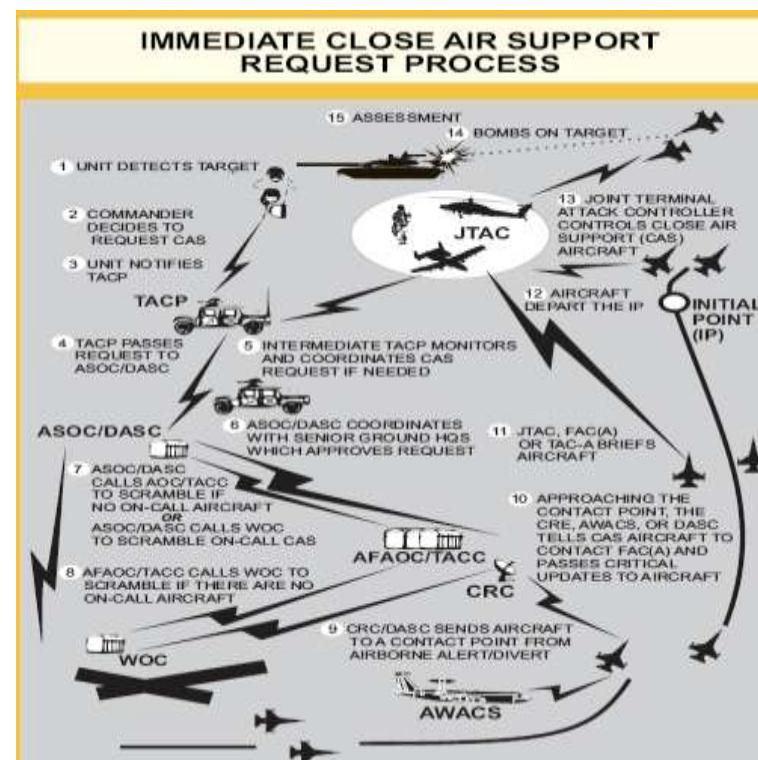
# Overview

- Developing Enterprise Architecture
- Using Activity Models to develop Executable Architectures
- Leveraging Executable Architectures for use in Engineering Analysis, Testing, and Training



# Develop Enterprise Architecture (Joint Close Air Support Example)

- **Mission Thread Decomposition**
  - Multiple Doctrinal Sources, Service Architectures
  - Subject Matter Expert Inputs
  - Decompose tasks, activities, etc



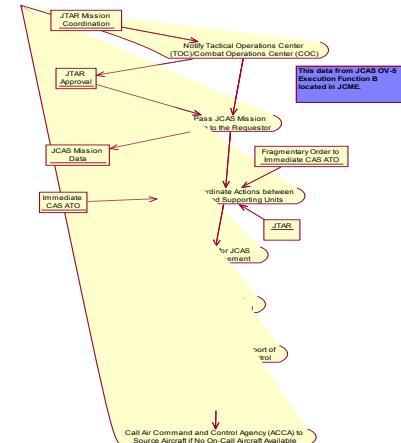


# Develop Enterprise Architecture (Joint Close Air Support Example)

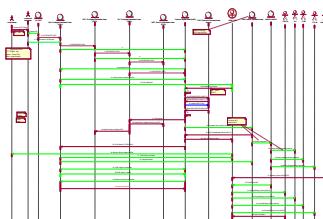
- **Develop DoDAF Architectural Views**
  - Core for executable is detailed Activity Model
  - Analyze for gaps, shortfalls, etc.



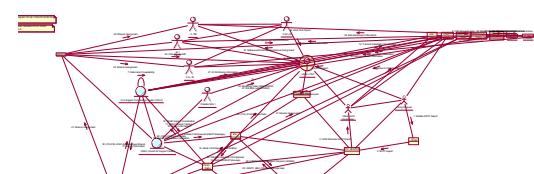
OV-1



OV-5 (Partial)



OV-6C



OV-2

Activity	Involved Node	Involved Node	Time
1	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	0:00
2	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	2:00
3	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	3:00
4	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	4:00
5	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	5:00
6	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	6:00
7	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	7:00
8	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	8:00
9	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	9:00
10	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	10:00
11	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	11:00
12	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	12:00
13	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	13:00
14	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	14:00
15	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	15:00
16	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	16:00
17	Initial Areas between 4d Supporting Units	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	17:00
18	Call Air Command and Control Agency (ACCA) to Source Aircraft if No On-Call Aircraft Available	Initial Areas between 4d Supporting Units	18:00

OV-3



# Develop Enterprise Architecture (Joint Close Air Support Example)

- Document Requirements, Capability, Gaps**
  - Desk Top Assessment (JCAS JBMC2 Final Report)

UNITED STATES JOINT FORCES COMMAND  
JOINT BATTLE MANAGEMENT  
COMMAND AND CONTROL

Joint Close Air Support  
Joint Mission Thread

Desk Top Analysis  
Final Report

UNITED STATES  
JOINT FORCES  
COMMAND

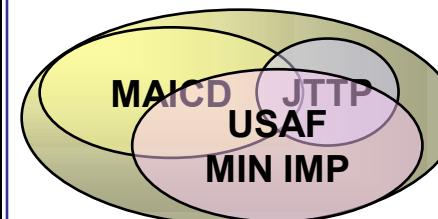
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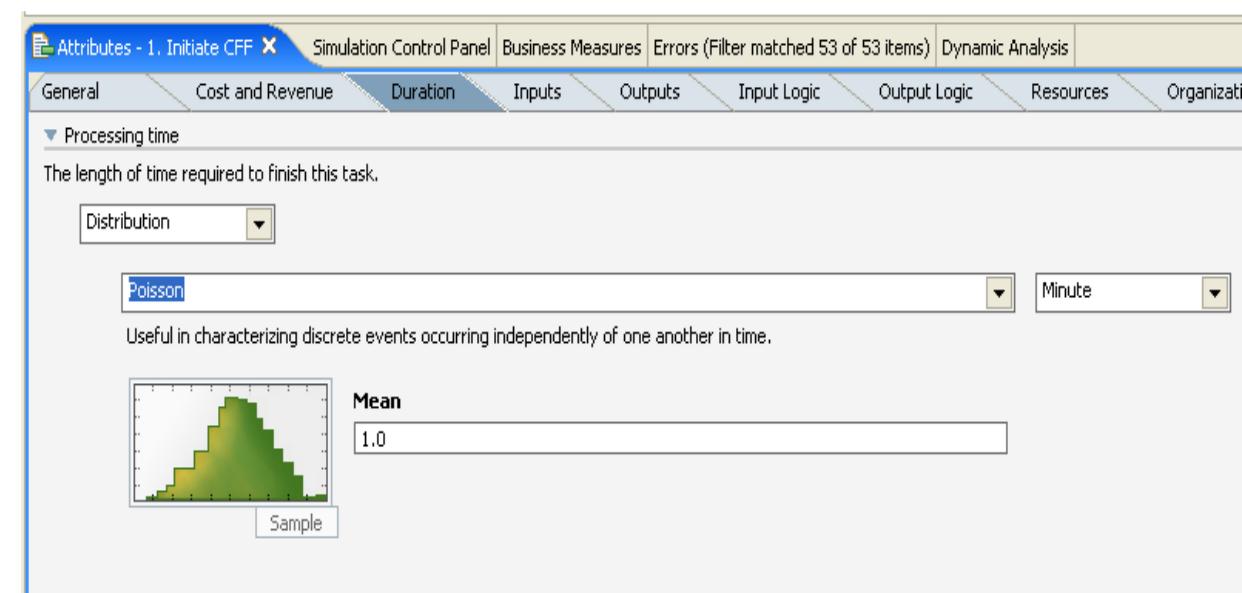
ELEMENTS	AF 6016	Doc	AH-1	AH-64D	F-16	AV-8	F/A-18	F-35	F-16	F-16	B-1	B-2
X = Existing capability												
P1 = Partial - requires voice ack												
P2 = Partial - only some F/A-18s												
P3 = remarks only												
AC/WPN TGT LOC & DESCRIPTION												
Tgt ID Serial Number/TGT Strength	X	X	X	X	X	X	X	X	X	X	X	X
Tgt ID Serial Number/TGT Name	X	X	X	X	X	X	X	X	X	X	X	X
Tgt Elevation	X	X	X	X	X	X	X	X	X	X	X	X
Tgt Course	X	X	X	X	X	X	X	X	X	X	X	X
Tgt Speed	X	X	X	X	X	X	X	X	X	X	X	X
Area tgt length, width, & altitude	X	X	X	X	X	X	X	X	X	X	X	X
Radius (NEW)	X	X	X	X	X	X	X	X	X	X	X	X
TGT Generic Type	X	X	X	X	X	X	X	X	X	X	X	X
Expanded TGT Description	X	X	X	X	X	X	X	X	X	X	X	X
Target Subtype	X	X	X	X	X	X	X	X	X	X	X	X
AC/WPN SYS AIM POINT (SP1/DGT)												
Desig TGT LOC (AC/RPT)	X	X	X	X	X	X	X	X	X	X	X	X
Desig TGT Elev (AC/RPT)	X	X	X	X	X	X	X	X	X	X	X	X
Desig TGT Source (AC/RPT)	X	X	X	X	X	X	X	X	X	X	X	X
JBFA												
Closet friendly LOC lat - long / UTM to tot	X	X	X	X	X	X	X	X	X	X	X	X
Number of friendly forces	X	X	X	X	X	X	X	X	X	X	X	X
Type of Friendly Forces	X	X	X	X	X	X	X	X	X	X	X	X
Direction of Friendlies from the target	X	X	X	X	X	X	X	X	X	X	X	X
Distance to Friendlies from the target	X	X	X	X	X	X	X	X	X	X	X	X
Custom Friendlies	X	X	X	X	X	X	X	X	X	X	X	X
Subtype	X	X	X	X	X	X	X	X	X	X	X	X
Size	X	X	X	X	X	X	X	X	X	X	X	X
Orientation	X	X	X	X	X	X	X	X	X	X	X	X
Activity	X	X	X	X	X	X	X	X	X	X	X	X
Course	X	X	X	X	X	X	X	X	X	X	X	X
Speed	X	X	X	X	X	X	X	X	X	X	X	X

Interpolate CRM, Chapter 11, 4.6.2.7-3(b) [AF 6016 - Aircraft Technical Information Manual (ATIM)]	Closest friendly LOC lat - long / UTM to tot	Number of friendly forces	Type of Friendly Forces	Direction of Friendlies from the target	Distance to Friendlies from the target	Custom Friendlies	Subtype	Size	Orientation	Activity	Course	Speed
AF 6016												
Doc												
AH-1												
WXR												
CATS												
AH-64D												
AFAPD												
AFMS												
AV-8												
TDF RQ												
TFD RQ												
6017												
SADS												
MIDS												
MDS												



# Develop Executable Architecture

- **Simulation tools provide capability to compare processes, time, costs, return on investments**
  - Input Time/Resources (distributions)
  - Map to Requirements, Tasks, etc.
- **Scenario-based**
- **Assumptions**



Sample Distributions in WBM

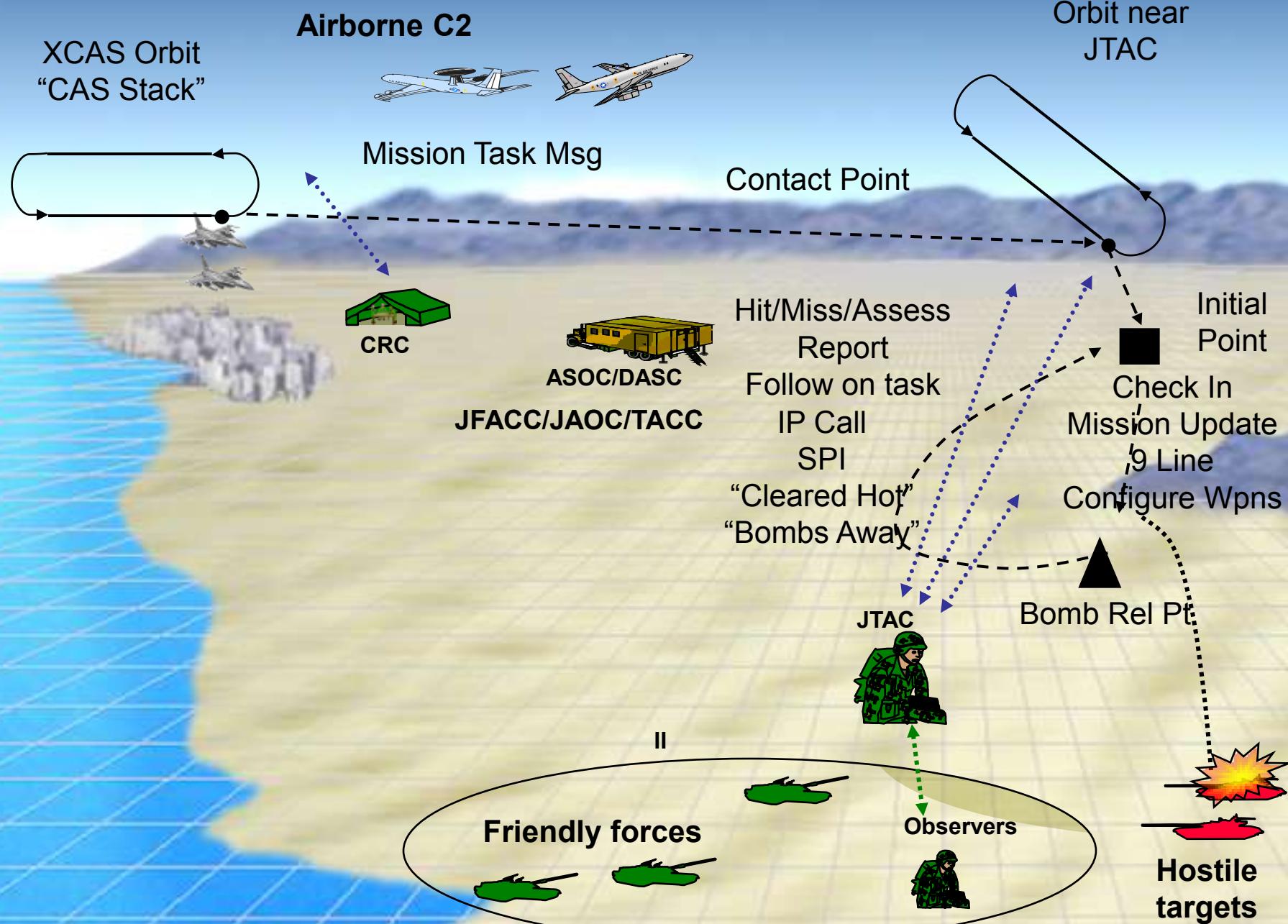


# JCAS Example

## (Digital vs. Voice Comparison)

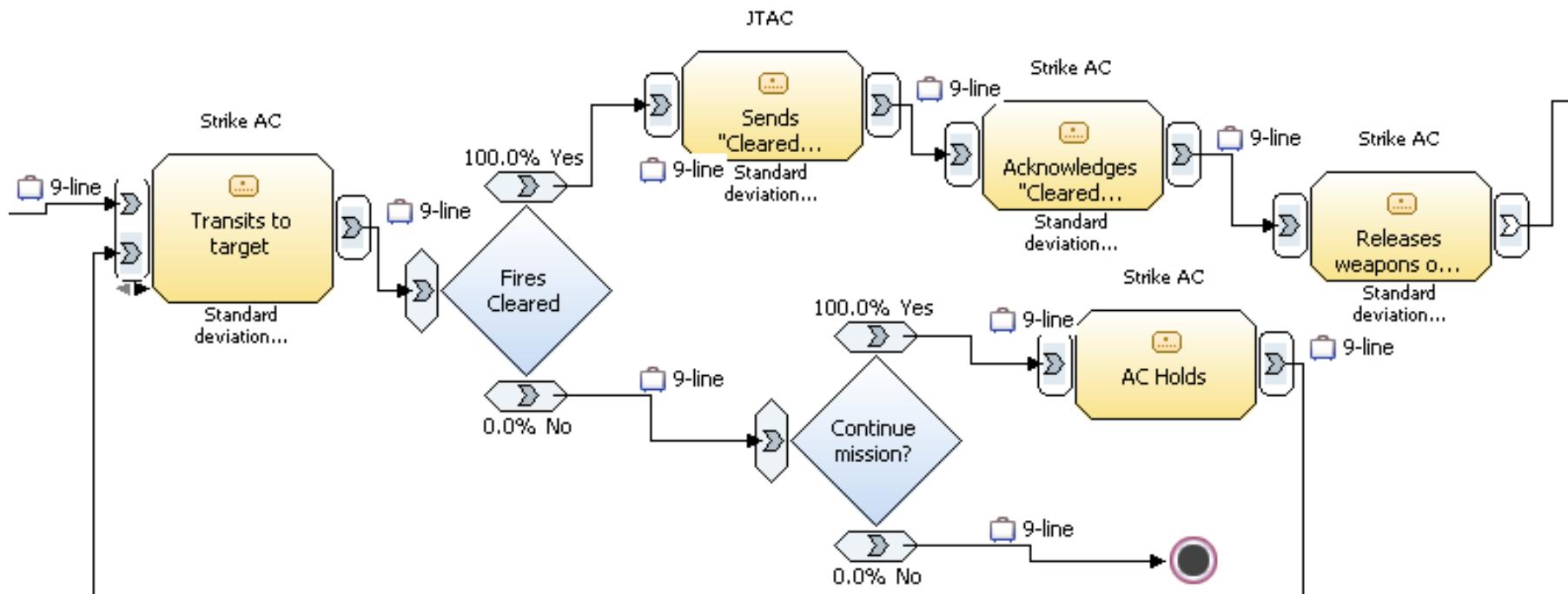
- **Compare process from mission assignment to mission completion using "as is" architecture against a "to be" architecture that maximizes digital transmissions.**
- **Model: JCAS Model Scenario:**
  - Scenario 1: Aircraft in XCAS Stack conducts mission from Mission Assignment to BDA
  - Scenario 2: Aircraft conducts entire mission from Contact Point
- **Metrics**
  - Time between Voice “As is” and Digital “To Be”
  - Capability increase
  - Accuracy

# JCAS JMT (Digital vs. Voice Scenario)





# Executable Architecture (Joint Close Air Support Example)

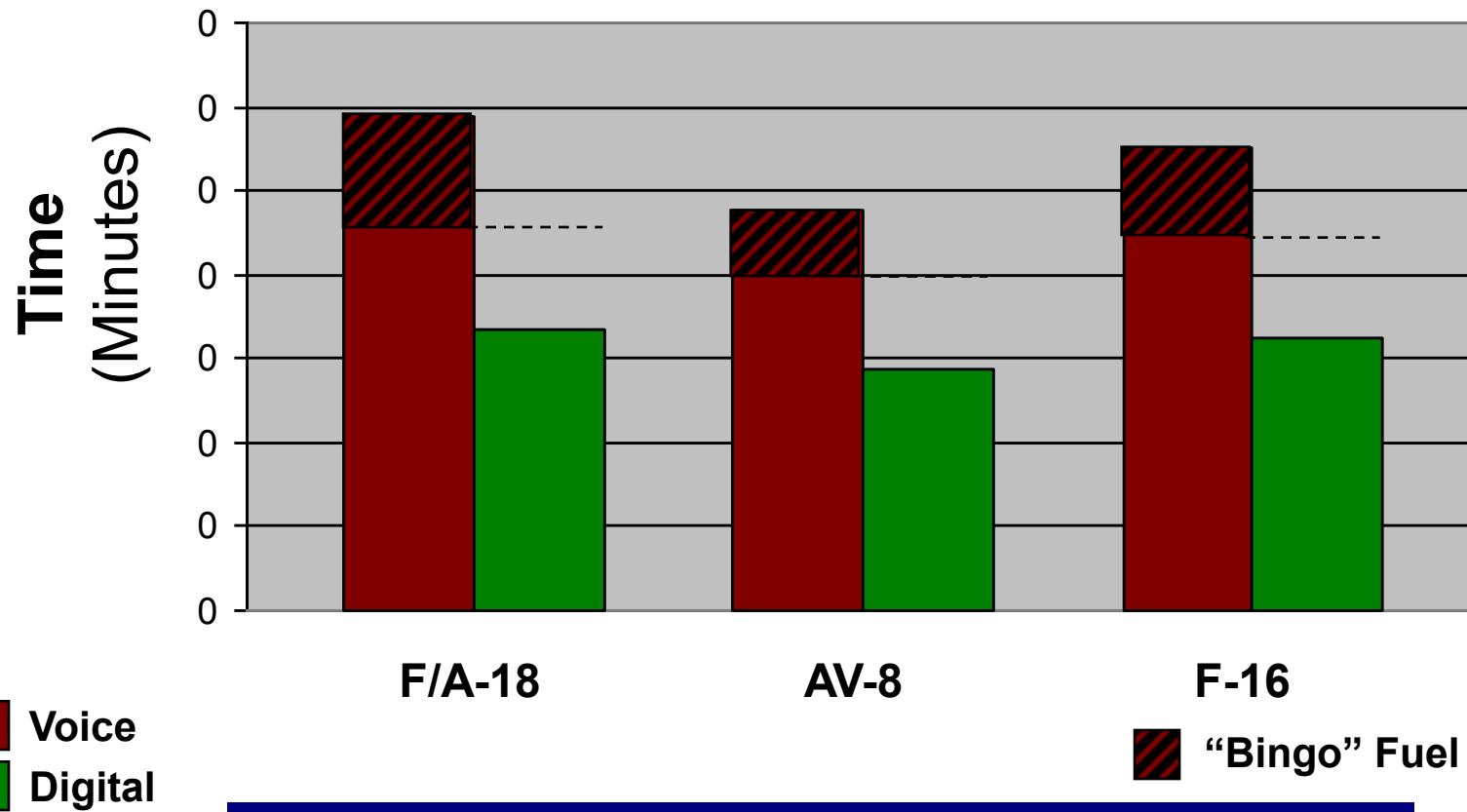


**USJFCOM/J89 JCAS Executable Architecture (Partial View)**



# Digital vs. Voice Comparison Results

Complete XCAS Mission  
(mission assignment through mission completion)



**40-44% Time Savings Using Digital  
More Weapons Employed, More Fuel Available**



# Digital vs. Voice Analyzed

## 10 Day Operations

	A-10		F-16		F/A-18		B-1		B-52		AV-8	
	Voice	Dig	Voice	Dig	Voice	Dig	Voice	Dig	Voice	Dig	Voice	Dig
Avg number of strikes/section	5.0	6.0	6.4	8	6.9	12.6	13.4	24	11	12	3.5	3.9
12 Ship (surge) squadron strikes (10 days)	900	1080	1151	1440	1259	2273	1605	2880	1324	1440	1050	1170
Days needed to strike same number of targets	10	8.34	10	7.99	10	5.54	10	5.57	10	9.19	10	8.97

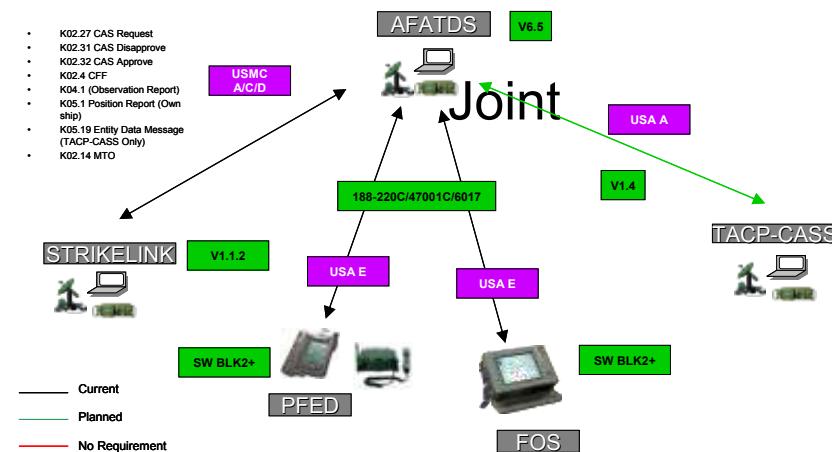
\*Based on average loiter times & sortie rates

**Results Feed Other Models (EADSIM, JAS, STORM, etc)**



# Executable Architectures Applied (Joint Close Air Support Example)

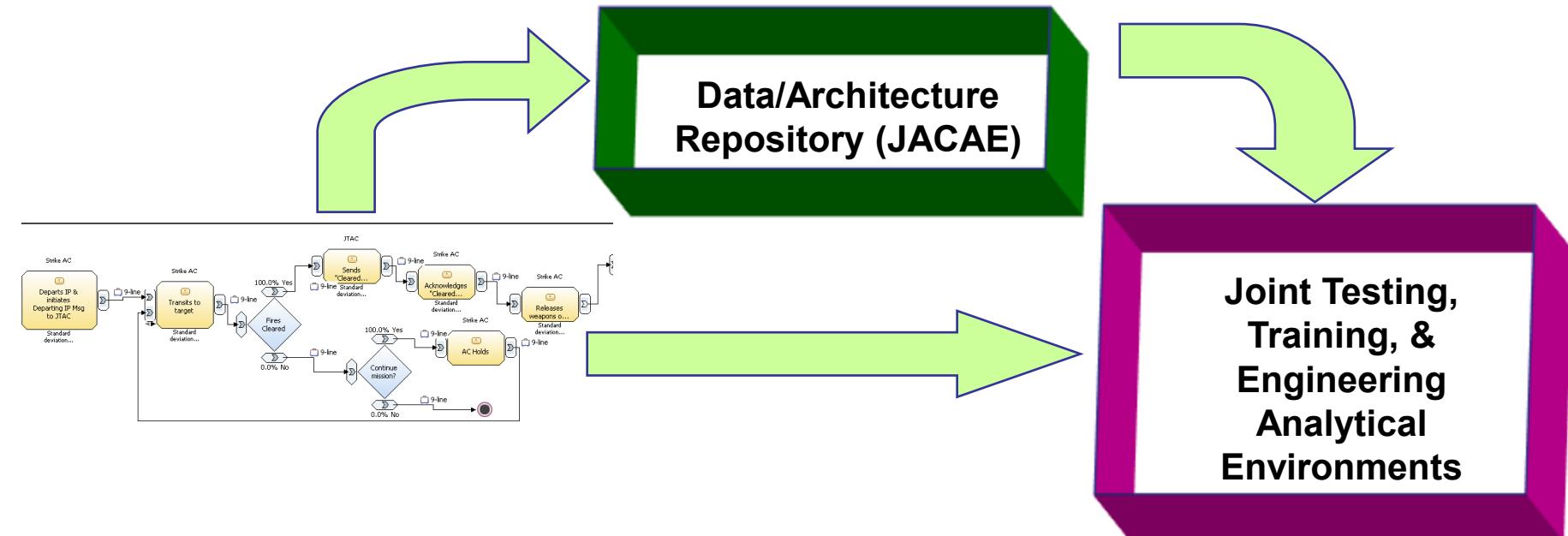
- **Operational Assessments**
  - “Bold Quest”
  - Interoperability Evaluation
- **Testing**
  - Exercise “Integral Fires 07”
  - MOE/MOPs for Test Threads
    - Timeliness
    - Accuracy
  - Traceability to Test Threads





# Document for Reusability

- **Objects, scenarios, tasks, sub-tasks, etc.**
  - Joint C2 (JC2) Architecture and Capability Assessment Enterprise (JACAE)
- **Available for Analytical Environments**
- **Validation, Verification, & Accreditation**
- **Coordinated Implementation**





# Coordinated Implementation (Joint Close Air Support Example)

- Planned
- ■ ■ JFCOM Proposed

# Participation Scope: TBD





# Executable Architecture Benefits

- Enables Structured Analytical Approach
  - Complete mission decomposition, including requirements, capabilities, & gaps
  - Documented through DoDAF (Core Activity Model)
  - Provides reusable repository of objects, scenarios, tasks, etc.
- Predictive Analysis
  - Generates MOE/MOPs for Gap/Trade analysis to support on going Functional Solutions Analyses
  - Results feed other models (JAS, STORM, EADSIM, etc)
  - Coordinate Implementation across Service and COCOM boundaries
- Risk Mitigation
  - Provide an environment for Joint Testing
  - Operational Assessments
  - Exercises

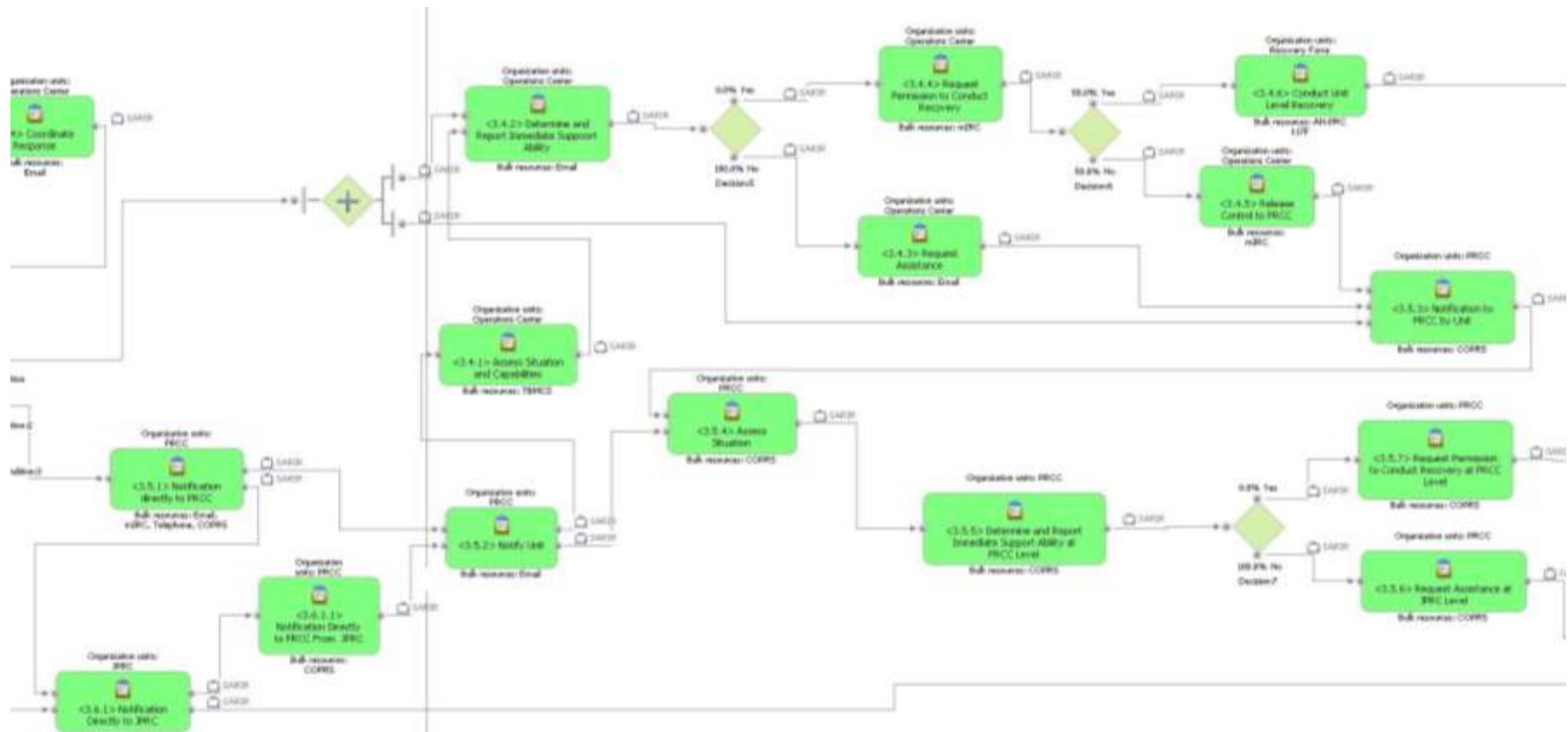


# Summary

- Build Enterprise Architecture of a Mission Thread
  - Decompose tasks, activities, etc.
  - Document Requirements, Current Capability, Gaps
  - Documented through DoDAF (Core Activity Model)
- Using Activity Model, develop Executable Architecture
- Leverage Executable Architecture
  - Generate MOE/MOPs for Gap/Trade analysis
  - Provide an environment for Joint Testing
  - Inputs to other models (mission level/campaign level)
- Build a common repository of objects, scenarios, tasks, sub-tasks, etc.
- Reuse in Engineering Analysis, Testing, and Training



# USJFCOM/J89 Way Ahead (Personnel Recovery)

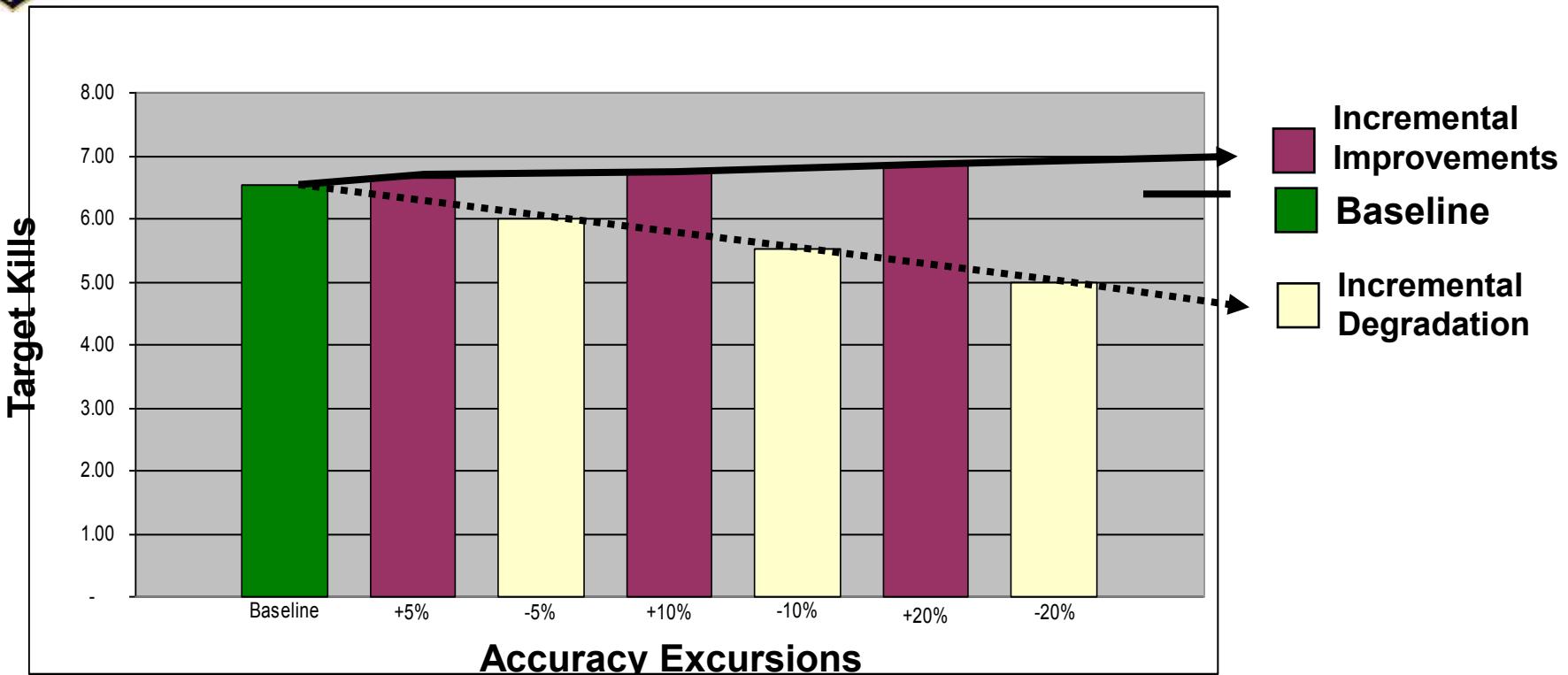




# Questions



# Accuracy Analysis



- Model: F/A-18 Digital Execution
- Assumptions
  - 1 x F/A-18 w/ 8 JDAM
  - 1 Target per weapon per pass
  - Lethal Radius: 60 m
  - Target Location Error: JCAS MT-3 (LRF/GPS)
  - Circular Error: Lognormal distribution between 1-40 m, centered at 13 m
  - For accuracy excursions, either incremental improvements or degradations of 5%, 10%, and 20% made to target location errors